

### REMARKS

In the Office Action mailed June 25, 2003, claims 21, 23, and 27–31 stand rejected under 35 U.S.C. § 102(e), or in the alternative, under 35 U.S.C. § 103(a) over *Tobben et al.* Claims 24–26 also stand rejected under 35 U.S.C. § 103(a) over *Tobben*. In addition, claims 21–31 stand rejected under 35 U.S.C. § 112, 1<sup>st</sup> and 2<sup>nd</sup> paragraph.

Claim 21 is amended to recite “forming a second hard mask layer from a remaining portion of the cap layer” and that “the first mask layer is removed prior to the etching of the wiring line layer.” Support for this amendment can be found in the specification at page 12, lines 2–9.

The amendment also adds claims 32–44. Support for claims 32–39 can be found in the specification at page 12, lines 6–9, which describes a decrease in the likelihood of contaminants such as carbon compounds being deposited within the gaps between the wiring lines when the photoresist layer is removed prior to etching the wiring lines. Support for claims 40–44 can be found at page 13, lines 20–30, and Figure 8, which shows cap layer 78 having facets formed by etching away a corner of cap layer 78 without exposing a top corner of the underlying wiring line 34.

Claims 21–44 are now pending in the application. Reconsideration and withdrawal of the rejections is respectfully requested in view of the amendment and the following remarks.

#### A. The Rejections of the Claims under § 112

Claims 21–31 have been rejected under 35 U.S.C. § 112, 1<sup>st</sup> and 2<sup>nd</sup> paragraphs, because, according to the Office, it is unclear where support exists for the etching of the mask layer, what operations are encompassed by the steps of forming and etching the mask layer, and how these steps differ from the conventional process of developing a patterned mask layer. This rejection is traversed.

FIG. 1 clearly depicts etching mask layer 30 as a patterned photoresist layer where portions of the layer have been removed to form the mask pattern. The accompanying description at page 10, lines 20–21 states that “the

photoresist layer is shaped to form an etching mask 30." It is well understood by those of skill in the art that etching can remove portions of a photoresist layer in order to shape it into a patterned mask. Moreover, the term "etching" is used numerous times in the specification to describe how patterns are formed in mask layers. See, e.g., page 10, lines 23–25 stating that the cap lay 28 may be etched to complete a hard mask for etching and noting that, alternatively, "the photoresist layer itself may be used as the mask."

The many descriptions in the specification of mask layers being formed by etching, as well as the fact that etching a well-known technique for forming patterns in mask layers, provide adequate support for "etching the first mask layer" in claim 21. Accordingly withdrawal of the rejection of claims 21–31 under 35 U.S.C. § 112, 1<sup>st</sup> and 2<sup>nd</sup> paragraphs, is respectfully requested.

B. The Rejection of the Claims under § 102/103 over *Tobben*

Claims 21, 23 and 27–31 have been rejected under 35 U.S.C. § 102(e), or in the alternative, under 35 U.S.C. § 103(a) over U.S. Patent No. 5,854,126 to *Tobben et al.* In addition, claims 24–26 have also been rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 5,854,126 to *Tobben et al.* The rejections over *Tobben* are made moot by the amendment.

Claim 21, as amended, recites "the first mask layer is removed prior to the etching of the wiring line layer." As noted above, in some embodiments it is preferable to reduce the likelihood of contaminants being deposited within the gaps between the wiring lines. Thus, in such embodiments, a first mask layer, such as a photoresist layer, is removed prior to etching the wiring lines, and a second "hard" mask is used instead to etch such wiring lines.

In contrast, Figure 5 of *Tobben* shows both the planarization layer 16 and the photoresist layer 18 present when metal layer 14 is being etched. The reference also describes grooves 38 being etched into the metal layer 14 before the photoresist and planarization layers are removed. See *Tobben*, col. 3, line 62 to col. 4, line 4. Nothing in *Tobben* describes removing a photoresist layer prior to etching a metal layer, nor suggests that particles from the photoresist layer can contaminate the grooves being etched into the metal layer.

Claim 21 has also been amended to recite "forming a second hard mask from a remaining portion of the cap layer." *Tobben* lacks any description of a second hard mask. Moreover, *Tobben* describes a cap layer, which forms part of planarization layer 16, as etching at a higher rate than an underlying metal layer 14, such that the metal layer itself acts as the etch stop layer. See *Tobben*, col. 3, lines 45–46. If anything, this description teaches away from a cap layer being formed into a hard mask that protects the underlying metal layer during etching.

In fact, none of the layers are described as protecting the metal layer from damage during an etching process, whether such etching is a result of an RIE etch, a sputter etch from an HDPCVD process, or some other process. This clearly demonstrates that while *Tobben* mentions HDPCVD as an alternative deposition technique, the reference does not appreciate the problems associated with HDPCVD damaging underlying metal layers, particularly during deep-gap fill operations. The description in *Tobben* is limited to an SOG layer that is not hard enough to protect underlying metal lines from HDPCVD processes such deep gap filling that have a high sputtering rate component. The oxide layer 16a in *Tobben* is similarly described merely as an adhesion promoter, and thus is also unsuitable for protecting the underlying metal layer during HDPCVD processes with a high sputtering rate component. There is simply no description or suggestion in *Tobben* that the overlying layers should protect the underlying metal layer from being damaged during an HDPCVD process.

In summary, *Tobben* neither discloses nor suggests the second hard mask, nor the step of removing the mask before etching the wiring lines. Moreover, *Tobben* makes no mention that layer 16 (the SOG planarization layer 16b and/or the silicon dioxide layer 16a) is suitable as a hard mask, or could be used in such a fashion. Accordingly, this claim, and those that depend from it, should be in allowable form.

The present amendment also adds new independent claim 36, which recites that "the cap layer is substantially free of carbon compounds." *Tobben* teaches away from this element as well by noting that planarization layer 16 is made of silicon containing organic compounds that get spun onto the metal layer.

See *Tobben*, col. 2, lines 57–64. For at least this reason, this claim and those that depend from it should be in allowable form.

Finally, new independent claim 40 includes another element that is lacking in *Tobben*. Claim 40 recites “forming a cap layer comprising nitride and/or silicon rich-oxide above the wiring layer.” These materials harden the cap layer allowing it to protect top corner sections of underlying material even when an HDPCVD sputter rate is high enough to etch the cap layer. As noted above, *Tobben* not only lacks any description of these materials in a cap layer, but actually teaches away from them by describing the cap layer as having a higher etch rate than the underlying metal layer. Thus, claim 40, and the claims that depend from it, are distinguishable over *Tobben* for this reason as well.

For at least these reasons, *Tobben* neither describes nor suggests all the elements of claims 21–44. Accordingly, withdrawal of the rejection of claims 21, 21, 23 and 27–31 under § 102(e) or § 103(a), and claims 24–26 under § 103(a) over *Tobben* is respectfully requested.

#### C. The Rejection of the Claims under Obviousness-Type Double Patenting

Claims 21–31 have been rejected under the judicially created doctrine of obviousness-type double patenting over U.S. Patent No. 6,117,345. In addition, the claims have been provisionally rejected under obviousness-type double patenting over U.S. Patent Application Serial No. 09/546,174. Upon the indication of allowable subject matter, a terminal disclaimer will be filed that makes the rejections moot.

#### D. Conclusion

In view of all of the above, claims 21–44 are believed to be allowable and the case in condition for allowance, which action is respectfully requested. Should the Examiner be of the opinion that a telephone conference would expedite the prosecution of this case, the Examiner is requested to contact Applicants' attorney at the telephone number listed below.

The fee for 4 additional dependent claims under 37 C.F.R. § 1.16(c) and a 2-month extension of time is enclosed herewith. No other fees are believed to be

Appl. No. 09/991,196  
Amdt. dated November 10, 2003  
Reply to Office action of June 25, 2003

required with this Response, and should any be required, please charge Deposit Account 50-1123. Should any additional extension of time be required, please consider this a petition therefore and charge the required fee to Deposit Account 50-1123.

Respectfully submitted,

November 10, 2003



Eugene J. Bernard, Reg. No. 42,320  
Hogan & Hartson L.L.P.  
1200 17<sup>th</sup> Street, Suite 1500  
Denver, Colorado 80202  
(303) 454-2457 (telephone)  
(303) 899-7333 (facsimile)